PiezoBot

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Summary:

For our project, we are working on a piezobot. By the end of the fall semester, we want to have a bot where it's either fully controlled or semi-controlled. At this point we are aiming to have our bot move on an X-Y plane and hopefully in the upcoming semester get to the point where the bots are communicating through some type of sensor which we are currently working on by researching and finding the best option. For our sensors, we are looking towards a light sensor or something equivalent. But our main goal is to find the right type of battery at the moment to power a motor to move the bot and the piezo disc. We have our microcontroller provided by our sponsor which we are required to use provided by microchip. Having all our equipment we are calculating what type of battery we will need and soon will be ordering equipment either this week or within the following weeks. Our goal is to have a functional PiezoBot to the point where we can mass produce multiple Bots to become a "swarm". We will achieve our needs and expectations in this report.

Statement of Needs:

In this Section, we will analyze the client's needs for the project. We will compare and weigh them using a matrix and objective tree.

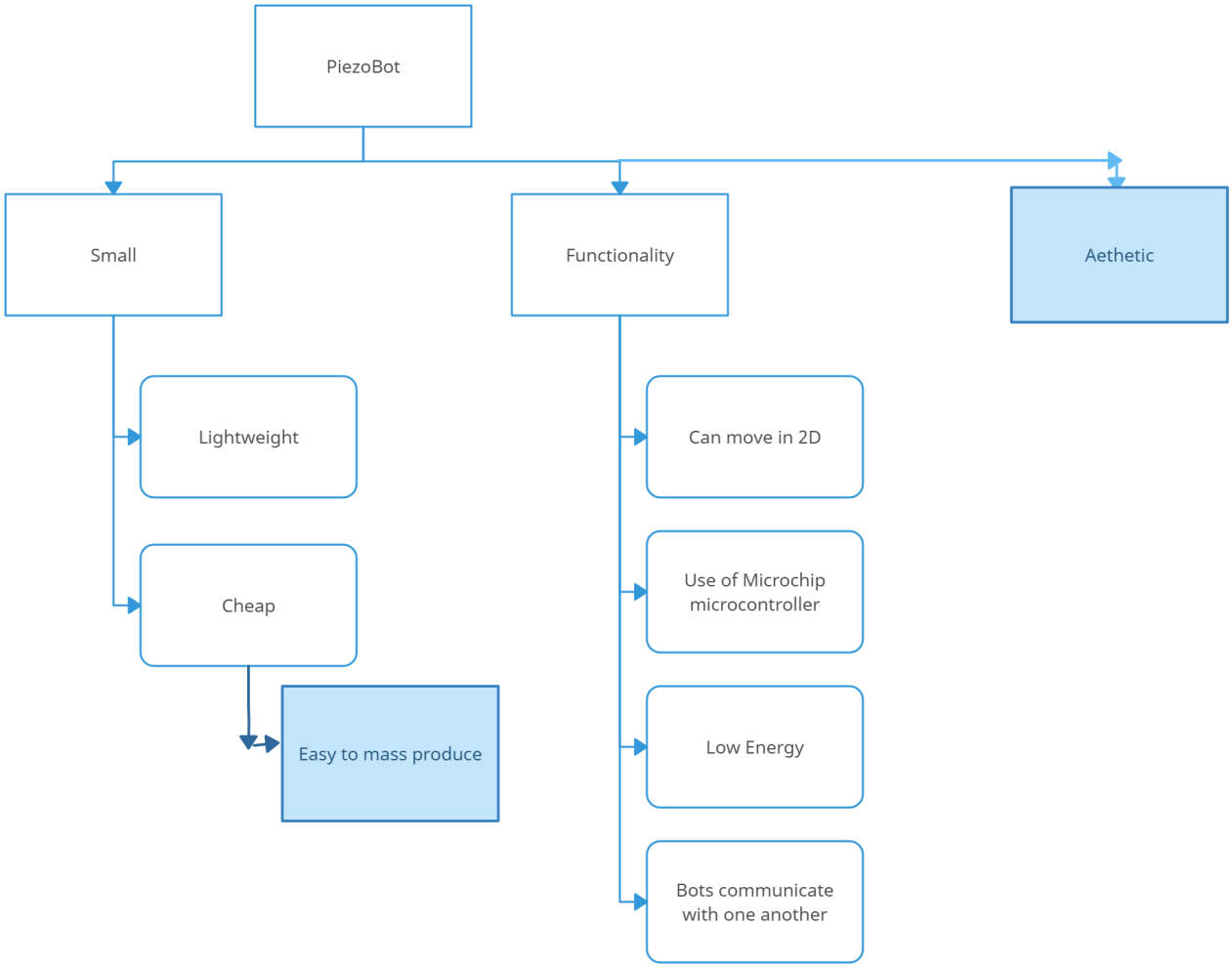
Marketing Requirements

- Small as possible
- Light weight
- Easy to manufacture/mass produce.
- Use Microchip microcontroller since they are sponsoring the project
- AVR 128 nano Board
- Low energy
- Use piezo disk

Additional Optional Customer Wants

- Bots are be able to communicate, i.e. with light or sound, not Bluetooth
- Multiple bots as deliverable to demonstrate communication
- Leave the door open to making the bots possibly fly

Diagram and Matrices:



	Small	Performance	Aesthetic	Sum	Weight
Small	1	0.25	4	5.25	0.31
Performance	4	1	5	10	0.6
Aesthetic	0.25	0.2	1	1.45	0.09
				16.7	

	2D	Energy	Communication	Light	Cheap	Sum	Weight
2D	1	5	4	3	3	16	0.413544
Energy	0.2	1	3	2	0.5	6.7	0.173171
Communication	0.25	0.33	1	2	0.25	3.83	0.098992
Light	0.33	0.5	0.5	1	0.5	2.83	0.073146
Cheap	0.33	2	4	2	1	9.33	0.241148
						38.69	1

Expectations

When we first met with the client, Dr. Cunha, he clearly stated that the final robot be functional in that it moves in the 2-dimensional plane for at least 3 feet. He wants to make it as small as possible with the option to make a communication system between multiple robots. When building the robot, we need to keep in mind that Dr. Cunha wants to mass produce these robots so selecting expensive parts for our robot would not be optimal for his requirements. Still, selecting some parts that might cost a little more but be smaller and/or perform better is something that we would keep in mind and possibly strive for when purchasing parts.

Statement of Objectives

By the end of the semester, we want to start getting to the point where we are designing and have all our equipment this semester. In this fall semester, we want to get as far as we can and at least to a point where we are hands-on. Have our recommendations for equipment by the end of December. Come to a point where we are designing and getting to a point where we are using Blender or some type of 3D programming and where we are almost testing to satisfy the “hands-on” part where we wish to be by December.

Get some type of movement by the end of the semester on an X-Y plane. Hopefully, we can have the robot moving so that we can start 3D designing and testing our piezobot and come to a point where we can move on to the next state of communicating with other piezobots and hopefully more than one bot by the end of the spring semester.

By the end of the fall semester, we want to have the deliverable, where the bot is moving and the goal moving on an X-Y plane. By January or the beginning of February, we want to have the robot functioning and begin working on the communication between the bots and we are leaning towards light sensors and some types of sensors, which are still being researched.

System Requirements

Technical:

- Low Energy
- Small as possible
- 2D Movement (at least “3 Feet”)
- Low cost
- Bots Communicate

Hardware and Software:

- Use MPLAB X software
- Use Microchip microcontroller (AVR128DB48-C Nano)
- Incorporate sensors as communication system between bots

Trade-Off Matrices:

Comm. = Communication	Move = Good Movement
Perform. = Performance	Manufac. = Manufacturability
Green = Higher/Good	Red = Lower/Bad
(-)= Negative Correlation	(+)= Good Correlation

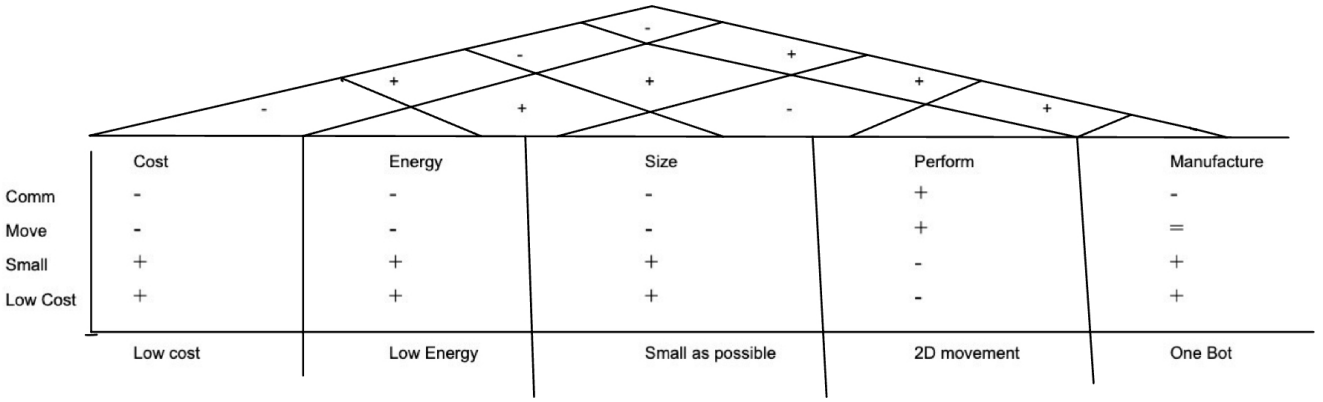
	Cost	Energy	Size	Perform.	Manfuc.
Comm.	-	-	-	+	-
Move	-	-	-	+	=
Small	+	+	+	-	+
Low Cost	+	+	+	-	+

Here in this matrix, “-” means negative correlation, and “+” means positive correlation. The green and red mean higher/good and lower/bad respectively. So for example having the robot be small is good and has a positive correlation with cost since we want a lower cost. This helps make it clear how our engineering requirements impact our client's requirements.

	Cost	Energy	Size	Perform.	Manufac.
Cost		-	+	-	+
Energy			+	+	+
Size				-	+
Perform.					-
Manufac.					

In this matrix, we compared the engineering trade-offs. Again, “-” means poor correlation, and “+” means good correlation. So cost and size both lower when the other lowers. This helps us understand the relationship between our given requirements.

House-of-Quality



This is the house of quality which was made based on the matrices. The requirements are very vague because at the moment we only have the goals of our robot and so we have to go off our budget of $500 to get accurate requirements for what we are aiming for.